

Topics in mid-term test

1. Wave parameters (η , β or k , average Poynting vector \vec{S}_{ave}) and Maxwell's equation; reflection & refraction of EM wave (Snell's law, θ_B , TE & TM polarization); plane wave, paraboloidal wave and spherical wave; time varying field versus phasor; Properties of media (linear, homogeneous, dispersive and isotropic).
2. Parameters for material dispersion (group velocity and index, D_ν , D_λ); conversion between parameters ($\Delta\lambda$ and $\Delta\nu$, D_ν and D_λ); Lorentz model
3. Paraxial approximation and slowly varying envelope approximation; Gaussian beam propagation; q parameter and its relation to various parameters ($1/q = 1/R - j\lambda/(\pi w^2)$, $z_0 = \pi w_0^2/\lambda$); power and divergence angle of Gaussian beam; Gaussian pulse propagation; $z_0 = -\pi\tau_0^2/D_\nu$
4. Jones vector and wave polarization (amplitude and phase); Jones matrix for retarder,

polarizer, rotator and coordinate rotation;

5. Anisotropic media (biaxial and uniaxial crystals); modified Snell's law; double refraction (birefringence, ordinary and extra-ordinary waves, ray direction); optic axis, index ellipsoid and k surface
6. Polarization devices: retarder (convert polarization), rotator (optical activity, Faraday effect, liquid crystal), modulator, polarizer, isolator
7. Simple optical components described by phase, interference effect (constructive, destructive conditions), interference of multiple beams, interferometers, lossless and lossy resonators (free spectral range, finesse)